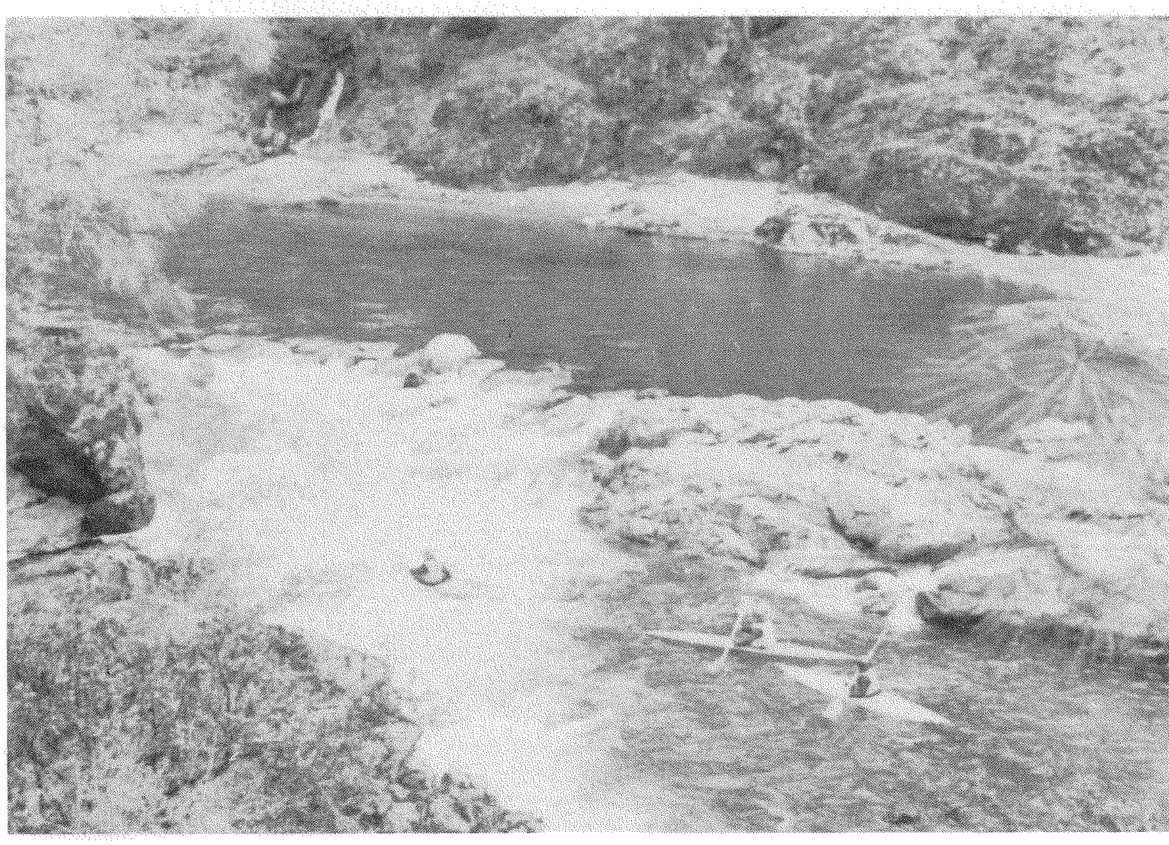
STATE OF CALIFORNIA

THE RESOURCES AGENCY

DEPARTMENT OF WATER RESOURCES

NORTHERN DISTRICT

MAIN STEM TRINITY RIVER WATERSHED EROSION INVESTIGATION



MARCH 1980

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WATERSHED EROSION INVESTIGATION

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FOREWORD

This report is the result of a one-year reconnaissance study of the main stem Trinity River watershed. The report provides data for evaluation of land and resource management options and should be used as a reference for in-depth, site-specific studies of problem areas.

The data presented include watershed maps of geology, landslides, instability and erosion hazard, mined areas and timber harvests. Turbidity samples collected from streams during high flows show relative turbidity in the watershed.

This report was prepared for the Trinity River Basin Fish and Wildlife Task Force by the Department of Water Resources, Northern District.

Albert J. Dolcini, Chief
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State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
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Photographs by Northern District - Red Bluff

CONVERSION FACTORS

Metric to Customary System of Measurement

Quantity	Metric Unit	Multiply by	To get customary equivalent
Length	millimetres (mm)	0.03937	inches (in)
	centimetres (cm) for snow depth	0.3937	inches (in)
	metres (m)	3.2808	feet (ft)
	kilometres (km)	0.62139	miles (m)
Area	square millimetres (mm^2)	0.00155	square inches (in^2)
	square metres (m^2)	10.764	square feet (ft^2)
	hectares (ha)	2.4710	acres (ac)
	square kilometres (km^2)	0.3861	square miles (mi^2)
Volume	litres (l)	0.26417	gallons (gal)
	megalitres	0.26417	million gallons (10^6 gal)
	cubic metres (m^3)	35.315	cubic feet (ft^3)
	cubic metres (m^3)	1.308	cubic yards (yd^3)
	cubic metres (m^3)	0.0008107	acre-feet (ac-ft)
	cubic dekametres (dam^3)	0.8107	acre-feet (ac-ft)
	cubic hectometres (hm^3)	0.8107	thousands of acre-feet
	cubic kilometres (km^3)	0.8107	millions of acre-feet
Flow	cubic metres per second (m^3/s)	35.315	cubic feet per second (ft^3/s)
	litres per minute (l/min)	0.26417	gallons per minute (gal/min)
	litres per day (l/day)	0.26417	gallons per day)(gal/day)
	megalitres per day (Ml/day)	0.26417	million gallons per day (mgd)
	cubic metres per day (m^3/day)	0.0008107	acre-feet per day
Mass	kilograms (kg)	2.2046	pounds (lb)
	tonne (t)	1.1023	tons (short, 2,000 lb)
Velocity	metres per second (m/s)	3.2808	feet per second (ft/s)
Power	kilowatts (kW)	1.3405	horsepower (hp)
Pressure	kilopascals (kPa)	0.145054	pounds per square inch (psi)
	kilopascals (kPa)	0.33456	feet head of water
Specific capacity	litres per minute per metre drawdown	0.08052	gallons per minute per foot drawdown
Concentration	milligrams per litre (mg/l)	1.0	parts per million
Electrical conductivity	microsiemens per centimetre ($\mu S/cm$)	1.0	micromho per centimetre
Temperature	degrees Celsius (°C)	(1.8 × °C) + 32	degree Fahrenheit (°F)

INTRODUCTION

The main stem Trinity River flows through the Klamath Mountains of Northern California (Figure 1). Largest tributary of the Klamath River, the Trinity drains an area of 7 700 km^2, with the South Fork comprising 2 460 km^2 and the rest of the main stem watershed comprising 5 240 km^2.

The main stem investigation includes all the Trinity River watershed except for the South Fork. The South Fork was studied separately (Buer and James, 1979), and in more detail, because it has a serious turbidity problem.

Location

The main stem basin lies in Trinity County and eastern Humboldt County, a rugged, sparsely populated region. Weaverville, the Trinity County seat, is in the southeastern section of the watershed. State Route 299 is the main east-west road. It parallels the Trinity River for most of the 120 km (75 mi) from Douglas City to Willow Creek (Photo 1). At the town of Willow Creek, Highway 299 leaves the river and State Route 96 then follows the Trinity from Willow Creek north for 35 km (22 mi), through the town of Hoopa to Weitchpec. Here the Trinity flows into the Klamath River. California Highway 3 connects Weaverville with Hayfork to the southwest, and Trinity Center and Carrville to the north. Highway 3 is the primary access road to resorts and towns along Clair Engle and Lewiston Lakes.

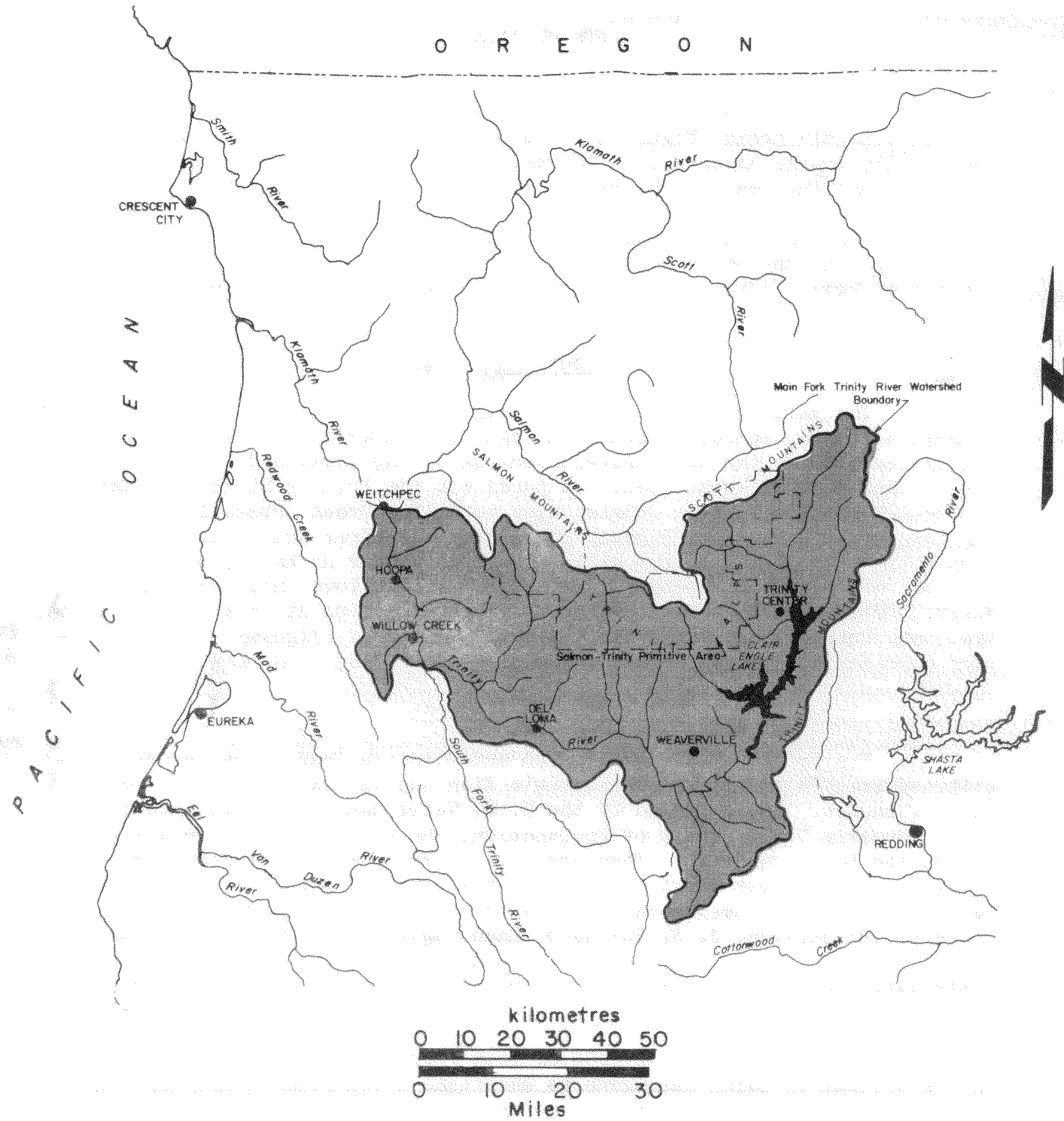
Task Force Involvement

The Trinity River Basin Fish and Wildlife Task Force was reconstituted in 1974 to resolve the basin's fish and wildlife problems, regardless of causes. It is funded by the U. S. Water and Power Resources Service (formerly U. S. Bureau of Reclamation) and composed of 13 Federal, State, and Local agencies. They are: U. S. Water and Power Resources Service, U. S. Forest Service, U. S. Fish and Wildlife Service, California Department of Water Resources and Department of Fish and Game, U. S. Soil Conservation Service, U. S. Bureau of Land Management, Bureau of Indian Affairs, Hoopa Indian Council, Trinity and Humboldt Counties, California State Water Resources Control Board, and the National Marine Fisheries Service.

In January 1977, $67,000 of Task Force funds were allotted to the Department of Water Resources to undertake a one-year study, the "Main Stem Trinity River Erosion Investigation". The objective was to collect basic data and identify erosion problems in the basin.

Scope of Study

The first part of the study included compilation of a bibliography related to geology, soils, precipitation, and sediment production in northwestern California. A study was made of erosion and erosion



Location Map

Main Stem Trinity River Watershed

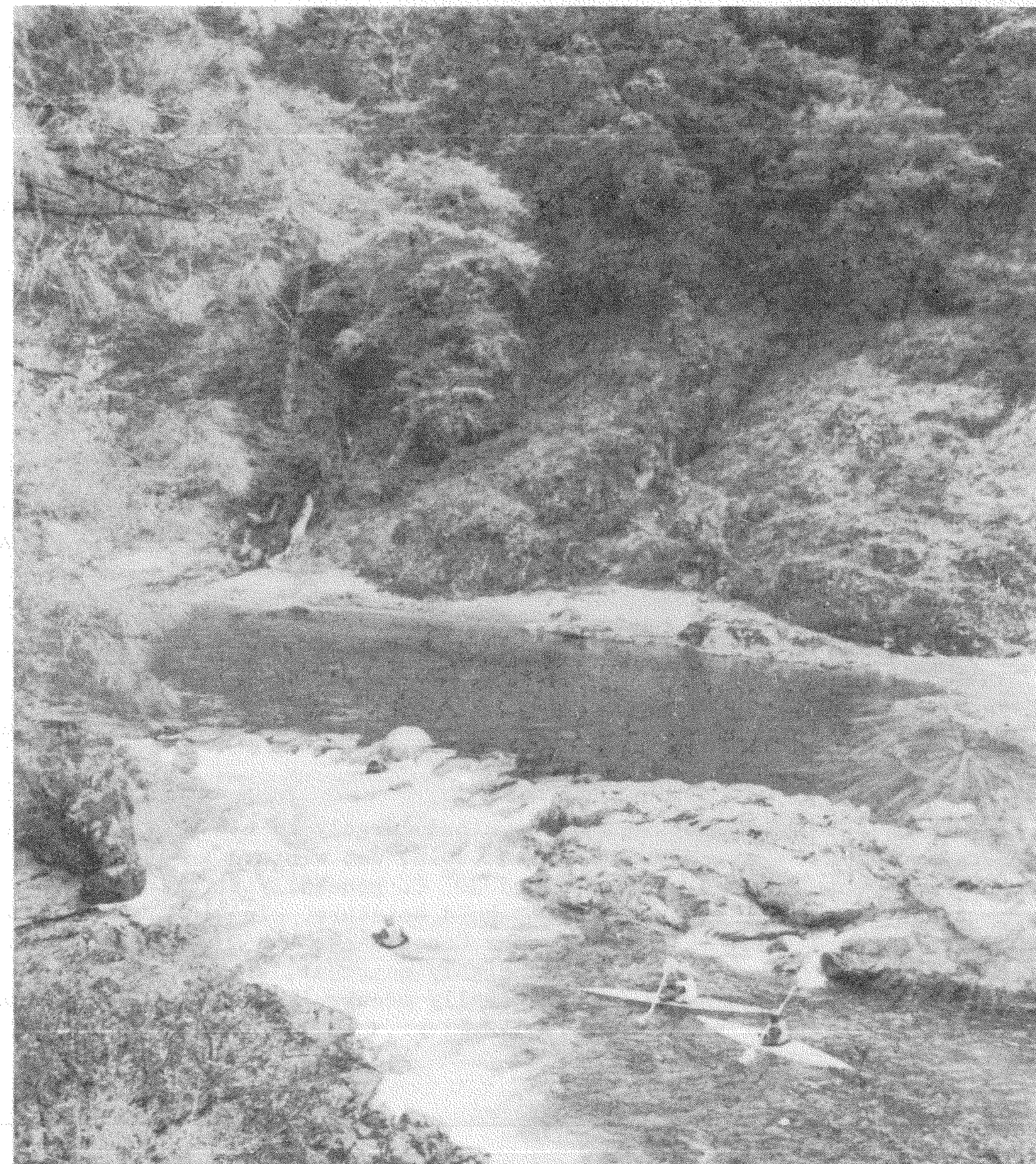


Photo 1. Kayaks on the Trinity River near Rowdy Bar Creek. Tourism and recreation are major sources of revenue in Trinity County.

control in forested and deforested lands, and the problems of timber harvesting in geologically unstable areas. Consultation and coordination with other agencies yielded in-house reports, unpublished data, and relevant ongoing studies.

A geologic map was compiled on 15-minute (1:62,500 scale) contour maps using all available data. The map was prepared for use as a reference during field reconnaissance and later was used as a diagnostic tool in determining sediment source problems and solutions.

Aerial photos were used to develop a landslide map showing active and inactive landslides.

A timber harvest map was prepared showing size, decade, and method of harvest, and including burned areas over 16 hectares (ha) in size.

During the winter of 1977-78, turbidity samples were collected from selected streams during storms. Sampling stations were chosen to be representative of the watershed and where winter access was possible. Turbidity was measured (Hach Lab Turbidimeter) in Nephelometer Turbidity Units (NTU's). Fifty millilitre aliquots were filtered through a .45-micron millipore filter. The different densities of the filtrates provide visual comparison of stream turbidity.

An erosion hazard map was made showing areas of general instability and high sediment yield. It was developed by comparing available landslide, road hazard, geology, and topographic maps with observed areas of instability and high turbidity.

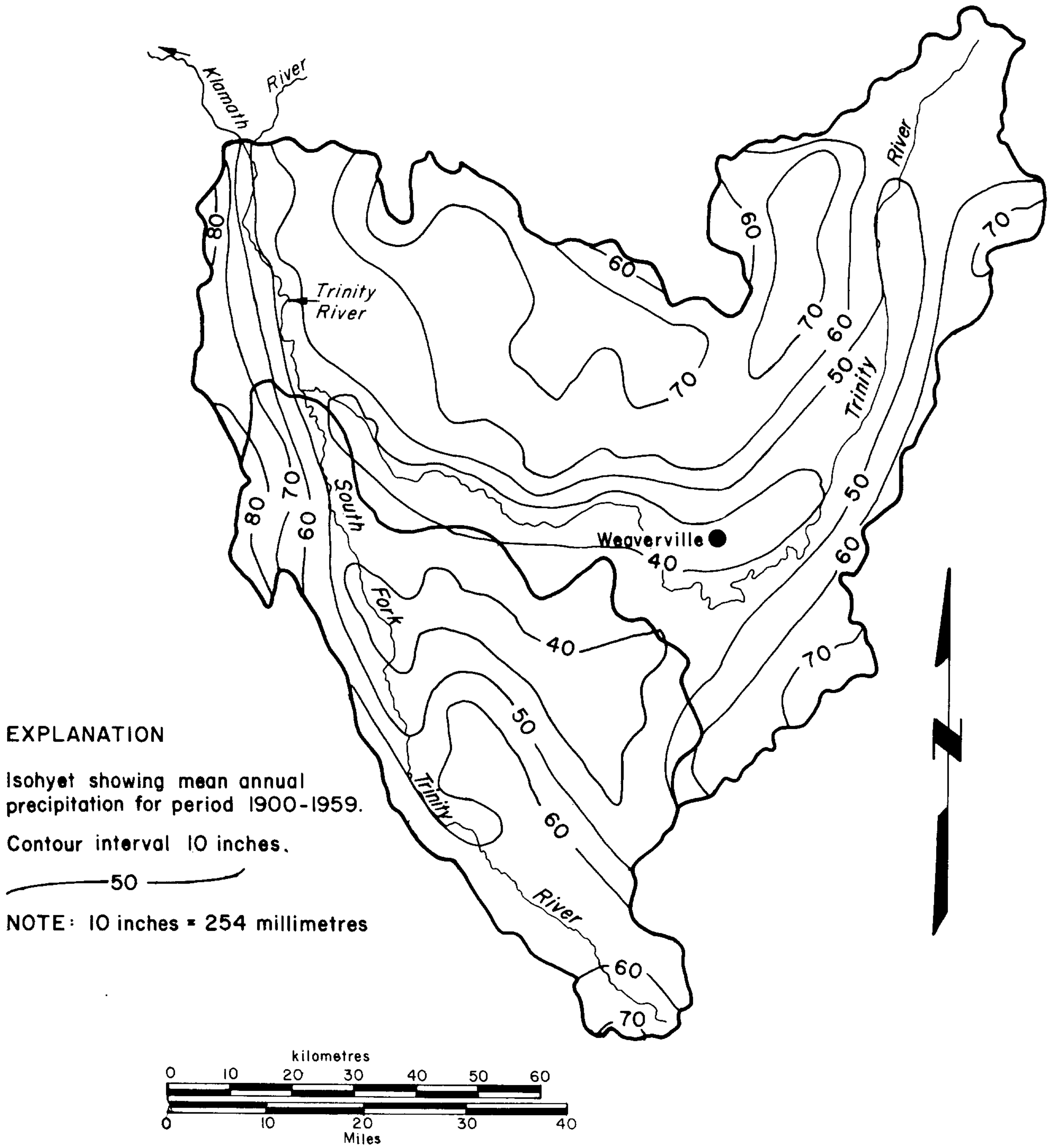
Climate

Climate of the basin is determined largely by its proximity to the Pacific Ocean. Hot, dry summers and cold, wet winters are typical. In summer, mountain temperatures around 38° C. generally warm the ocean breezes and increase their capacity to hold moisture. In winter, westerly winds from the Pacific are cooled by the Coast Range and Klamath Mountains. Precipitation (Figure 2) is therefore highly seasonal, with 90 percent falling between October and April. Snow usually occurs in areas above 1 200 m. Precipitation is lower along the Trinity River, and increases with elevation due to orographic lifting.

Vegetation

The most characteristic natural vegetation is Douglas fir intermixed with a few ponderosa and sugar pine and, less commonly, incense cedar. At elevations above 1 200 m, white fir shares the overstory with the Douglas fir in proportions that increase with elevation. There are scattered digger pines associated with calcic soils derived from serpentinized ultramafic rocks at lower elevations.

Figure 2



Isohyetal Map
Trinity River Basin

Brush rapidly invades openings in the forest caused by fire and timber harvest. Common brush species are white thorn, deer brush, bush chinquapin, blackberry, raspberry, and poison oak. Common hardwoods are black oak, canyon live oak, interior live oak, madrone, tan oak, giant chinquapin, bigleaf maple, and red alder.

Openings in the forest cover that are bare or supporting grass are found mainly in areas with roads, logging, slumps, landslides solifluction, bare bedrock, or soil chemical imbalances.

Physiography and Stream Morphology

The Trinity River is approximately 280 km in length and is the largest tributary of the Klamath River system. The Trinity heads in the Scott Mountains at 2 700 m elevation, and joins the Klamath near the town of Weitchpec.

Elevations of 1 800 to 2 100 m are common in the watershed, with peaks to 2 800 m. The canyons are rugged and deeply entrenched, with steep, wooded slopes. Tributary streams generally have narrow valleys with steep channel gradients. Tributary watersheds are shown in Plate 1 and watershed areas in Appendix A.

The watershed is roughly triangular in shape and surrounded by prominent mountain ranges, such as the Trinity Alps, Salmon and Scott Mountains on the north, South Fork Mountain on the west and the Trinity Mountains on the east.

Most of the Trinity River has a dendritic drainage pattern. However, its upper part, the South Fork, and parts of the lower main stem have drainages that follow the geologic structural trend.

SUMMARY

This study develops a data base for the Trinity River Fish and Wildlife Task Force to use in planning and decision-making in the watershed.

In the data collection phase, the Department first reconnoitered the watershed and then compiled: (1) a bibliography of pertinent references; (2) a geologic map of the watershed; (3) a landslide map, using aerial photos and ground observations; (4) a timber harvest and burn map from county tax records, U. S. Forest Service and California Department of Forestry timber harvest files; and (5) turbidity data, showing areas producing the highest turbidity.

Geologic units were then rated according to erosion hazard and landslide susceptibility. Serpentinite, Salmon Hornblende Schist, Rattlesnake Creek terrane, and the Shasta Bally Batholith have the highest hazard ratings in the watershed.

Human impact on parts of the watershed has been extensive. The Timber Harvest and Burn Map shows that 42 percent of the watershed has been logged during the period of record (up to 1977).

Mining activity has also been extensive; there are over 500 claims listed for Trinity County. Hydraulic gold mines scoured enormous amounts of terrace gravels into stream channels.

GEOLOGY

North coastal California contains two parallel geologic provinces which differ in age, lithology, structure, and metamorphism (Figure 3). The margin of the Pacific Ocean is bounded by the Coast Range Province, developed on rocks of the Franciscan Assemblage. The Franciscan sedimentary and volcanic rocks were deposited in a deep marine environment. They are often highly deformed and broken, but generally only slightly metamorphosed. This Coast Range Province occupies a very small area in the watershed.

East of the Coast Ranges are the older Klamath Mountains, underlain by metamorphic and plutonic rocks. The two provinces are separated by the South Fork Mountain Schist. To which province this schist belongs is a subject of debate (Blake, 1965; Suppe, 1973; Bishop, 1977; Jim Wright, personal communication), but it is included here in the Coast Ranges because its surficial aspect is very similar to those of the Coast Ranges.

Klamath Mountains Province

The Klamath Mountains occupy most of the watershed. The Klamaths were divided into the so-called "Eastern Klamath", "Central Metamorphic", "Western Paleozoic and Triassic" and "Western Jurassic" subprovinces (Irwin, 1960). The Western Paleozoic and Triassic subprovince is referred to here as the Jurassic to Permian subprovince, because fossils of those ages have been found there. These are shown in Figure 3 and on the geologic map, Plate 2.

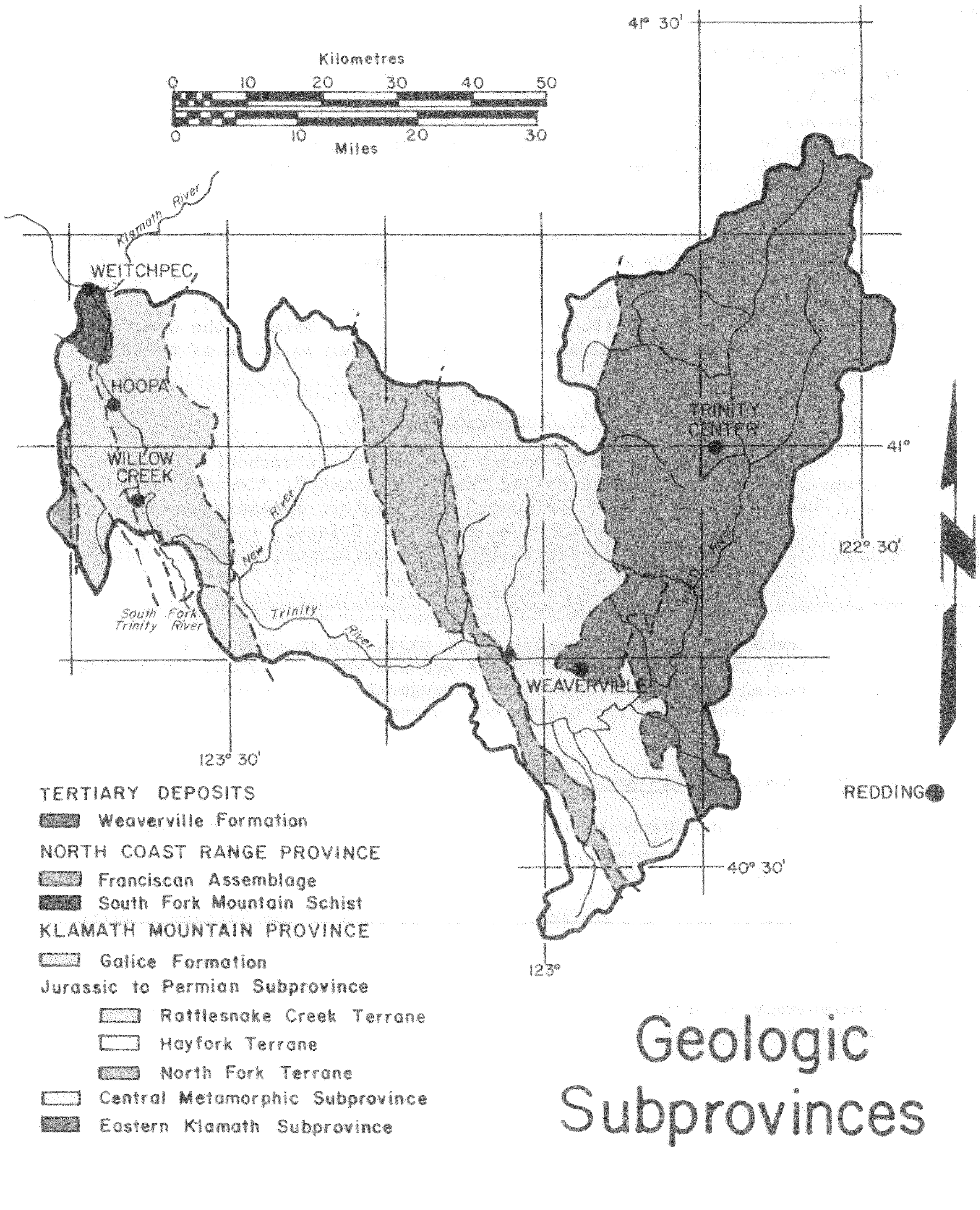
Rock units dip generally to the east, and in each case the older eastern unit overlies the younger western unit. Plutonic rocks are found intruding the metamorphic rocks throughout the watershed. Rock units will be described from oldest to youngest, or as they appear from east to west in Figure 3.

Eastern Klamath Subprovince

This subprovince occupies the eastern one-third of the watershed and includes the Trinity ultramafic sheet, Copley greenstone, and Bragdon Formation.

The Trinity ultramafic sheet is the base of the Eastern Klamath subprovince. It is believed to be part of an ophiolite sequence (Goulland, 1973). It is composed of largely serpentinized ultramafic rocks and medium- to coarse-grained gabbros and diorites. The gabbros and diorites are relatively erosion resistant, but the serpentinite is readily susceptible to mass movement.

Figure 3



Geologic Subprovinces

The Copley greenstone of Devonian age underlies the Bragdon, and consists of slightly metamorphosed spilites and keratophyres. Pillow structures are found locally. The unit is massive and competent.

The Bragdon Formation is the youngest unit of this group. The sediments are slightly metamorphosed, and have retained their sedimentary textures. The unit is estimated to be Mississippian in age. Only the upper part is found in this watershed. The unit is generally considered to be stable and erosion resistant.

Central Metamorphic Subprovince

West of the Eastern Klamath subprovince is the Central Metamorphic subprovince. Two medium- to high-grade metamorphic rock units comprise this group -- the Salmon Hornblende Schist and the Abrams Mica Schist. The Salmon is structurally lower. It is a moderately well foliated amphibolite facies metamorphic rock consisting of hornblende, epidote and albite. The Salmon Hornblende Schist is an erodible unit, releasing a large number of clay-sized amphibole crystals into the Trinity River.

The Abrams Mica Schist is a greenschist facies metasediment composed primarily of quartz, mica, chlorite and calcite. Slopes underlain by the schist are moderately stable but soils are generally erodible.

Jurassic to Permian Subprovince

This subprovince is subdivided into three terranes -- the North Fork, Hayfork, and Rattlesnake Creek (Irwin, 1972). These were once considered jointly as the Western Paleozoic and Triassic Belt (Irwin, 1960). The North Fork and Rattlesnake Creek terranes are believed to be tectonic "slices" of oceanic crust, or ophiolite suites. The Hayfork terrane probably originated as an island arc between the two (Irwin, 1972). The terranes are believed to be from Permian to Jurassic in age (Irwin, 1977), because fossils of those ages have been found there.

North Fork Terrane. This terrane is named after the North Fork Trinity River, located near Helena. It is a disrupted ophiolite sequence at the base, overlain by sediments to the east. Serpentinite, gabbro, and diabase form a practically continuous selvage along the western side. Outcrops of these rocks occur on Highway 3 near Hayfork Summit. The ophiolitic rocks are succeeded to the east by silicious tuff, chert, mafic volcanic rock, minor lenses of limestone, phyllite, and, locally, pebble conglomerate.

The igneous rocks and the sediments produce moderately stable slopes, while the serpentinites produce unstable slopes.

Hayfork Terrane. This terrane is named after the town of Hayfork, which lies within it in the South Fork Trinity watershed. The rocks consist of a distinctive pyroxene meta-andesite (Photo 2) with layers of

Photo 2. Looking north from Highway 299, New River cascades through the stable Hayfork Bally meta-andesite, producing the steep, rugged slopes.

slaty argillite, sandstone, pebble conglomerate, thin-bedded chert and sparse lenses of limestone (Irwin, 1972).

The Hayfork terrane has been divided into an upper, middle, and lower unit. North of the Trinity River, only the lower unit is differentiated, but south of the river the terrane is divided into: (1) an upper unit of mafic volcanic rocks, thin-bedded chert, quartzite, limestone lenses, and quartz keratophyre; (2) a middle unit of slaty argillite, sandstone, pebble conglomerate, with limestone lenses and breccia; and (3) a lower unit of the Hayfork Bally meta-andesite and Ironside Mountain batholith (Irwin, 1974).

Serpentinites, common in the North Fork terrane are rare in the Hayfork. The Ironside Mountain batholith is an integral part of the terrane. Because of the dioritic composition and general lack of expandable micas, erosion of this batholith does not normally contribute to serious sediment problems in the watershed. The terrane is generally stable and landslides are a relatively minor feature.

Rattlesnake Creek Terrane. The type locality of the Rattlesnake Creek terrane is in the watershed along Rattlesnake Creek, a tributary of the South Fork Trinity River. This unit includes rocks of Jurassic to Permian ages and is a tectonic melange formed of ophiolite and overlying deep-water sedimentary rocks intermixed with shallow water carbonates (Blake and Jones, 1977). The more common rock types are serpentinized ultramafics, gabbro, diabase, quartz diorite, pillow lava and other mafic volcanic rocks, phyllite, thin-bedded radiolarian chert, discontinuous lenses of limestone, and locally interbedded sandstone and pebble conglomerate. This unit is highly deformed and is structurally incompetent. Landslide features and other signs of instability are abundant.

Western Jurassic Subprovince

The western Jurassic subprovince consists of the Galice and Rogue Formations. The Galice is probably Upper Jurassic in age. It consists of interbedded graywacke, mudstone, and conglomerate and some volcanic rocks showing metamorphic variations from slate to schist.

Many debris slides occur in the Galice along the South Fork Trinity, where the river parallels the structure and dip-slopes are formed. The main stem Trinity crosses the structure, and here the Galice has moderately stable slopes.

Intercalated with the Galice is the Rogue Formation, consisting of metamorphosed volcanic flows and pyroclastic rocks that generally form stable slopes.

Intrusives

North and southeast of Weaverville are light-colored, coarse-grained, biotite, hornblende, quartz diorites of the Late Jurassic Shasta

Bally Batholith and associated Weaver Bally Batholith. Hillslopes underlain by these granitics are deeply weathered. Slopes are erodible and produce large volumes of sediment when protective vegetation is removed. Grass Valley and Little Grass Valley Creeks drain some of the area. To casual examination, they present the appearance of typical streams, hidden in many places by a heavy cover of vegetation. Closer inspection, however, reveals channel bottoms composed almost entirely of medium- to coarse-grained sand derived from highly unstable granitic parent rocks that cover about 80 percent of the basin. Through the weathering process, vegetation removal, and man-caused soil disturbance, a large amount of sandy soil eventually reaches the stream channel and is carried downstream. On entering the Trinity River, this sand settles out and blankets the streambed, covering spawning areas and filling deep fish-resting pools below Grass Valley Creek.

The Canyon Creek pluton in the north central part and the Ironside Mountain Batholith in the western half of the watershed are light- to medium-colored hornblende quartz diorites. They form steep slopes and rugged peaks and do not appear to present serious erosion problems.

North Coast Range Province

The Franciscan Assemblage and South Fork Mountain Schist are highly unstable units in the North Coast Range Province. They appear in very minor amounts in the main stem watershed along the western drainage divide.

Franciscan Assemblage

The Franciscan Assemblage underlies the larger part of the Coast Range. These rocks were deposited in a deep marine environment and consist of graywacke, shale, and minor amounts of submarine volcanic rocks, radiolarian chert, and foraminiferal limestone. The unit has been subdivided into two distinct types: coherent, or unbroken units, and melange or incoherent units (Blake, Jones, and Landis, 1974). The few outcrops of Franciscan in the basin are mostly gray-green graywackes of the first type. Minor interbeds include shale, pillow basalt, siltstones, and bedded cherts.

South Fork Mountain Schist

West of the Galice and along the east slope of South Fork Mountain is the South Fork Mountain Schist. The schist forms a narrow, 240-km-long selvage along much of the western boundary of the Klamath Mountains. It underlies about 50 km^2 along the western edge of the watershed. It is well foliated and crenulated and appears complexly contorted in outcrop. Unfortunately, on South Fork Mountain Schist there are few well exposed outcrops because of abundant colluvial debris. The schist consists mainly of fine-grained quartz-albite-muscovite-chlorite schist. The blueschist high pressure, low temperature minerals, crossite, lawsonite, and riebeckite occur in places. The Chinquapin metabasalt member has been metamorphosed to a fine-grained albite-chlorite-actinolite-epidote gneiss.

The colluvial soils of the South Fork Mountain Schist are unstable, but the landslide features are generally subdued and difficult to map due to dense vegetation.

Cretaceous, Tertiary, and Quaternary Sedimentary Deposits

Great Valley Sequence

Cretaceous rocks of the Great Valley occur as small, isolated patches in the watershed. The patches were part of a sheet of shallow-to-deep marine shelf deposits that at one time covered most of this part of the Klamath Mountains. Most of the sequence is firmly consolidated sandstone, conglomerate, and mudstone, with a more shaley upper part containing thin nodular beds. According to Irwin (1974), the section dips easterly. The rocks of the Great Valley are unstable, but are an insignificant part of the watershed.

Weaverville Formation

A large exposure of this unit can be observed at the type locality near the town of Weaverville. A few remnants of this Oligocene continental formation are preserved in fault-bound, down-dropped valleys and as terraces along the Trinity River. The formation consists of weakly consolidated mudstone, sandstone, conglomerate with an impervious dark green clay matrix, and sparse interbeds of light colored tuffs (Irwin, 1974). The Weaverville Formation tends to be unstable, particularly along roadcuts and streambanks where slopes are oversteepened.

Glacial Deposits

Glacial deposits are present in the northeastern region of the watershed, where the mountains were elevated above the snowline during the Pleistocene. Sharp (1960) defined at least four episodes of glaciation and found evidence for 30 valley glaciers during the latest episode (Late Wisconsian, locally named Morris Meadow).

Two cirque glaciers exist today at the top of Thompson Peak at 2 700 m elevation. Canyon, Coffee, and Swift Creeks and Stuart Fork were once glacial valleys. Glacial till, composed of unsorted gravels and boulders in a sand and clay matrix, is the principal deposit. Glaciation in Swift Creek produced glacial detritus from serpentinite bedrock. These deposits were sources of many debris flows during the Pleistocene. The flows traveled down the valleys from the glacier snouts and deposited sediment almost indistinguishable from till (Sharp, 1960).

Terrace Deposits

Much of the Trinity River upstream from Big Bar is flanked by terraces composed of gravel and sand from glacial erosion. Diller (1911) found Pleistocene fossils at the base of 41 m of gravels at Union Hill Mine (#68, Placer Mine Map, Plate 3) near Douglas City. Downstream from Big Bar to Hawkins Bar, the river flows through the Hayfork terrane (Figure 3 and Plate 2) which produced a steep, narrow gorge and a few bedrock terraces mantled by a layer of gravel. From Hawkins Bar downstream to the north end of Hoopa Valley, the river is underlain by erodible Galice slates. Here the river forms broad valleys of terrace deposits. Near the confluence with the South Fork Trinity River, there are six terrace levels at elevations 18 m to 305 m above present stream level. The middle terrace, 92 m above the stream, has been mined for gold.

Surficial Deposits

Surficial deposits include Recent Alluvium, lake deposits, mined terrace deposits, and landslide debris. The Recent Alluvium consists of well-washed sand, gravel, cobbles, and boulders, with some fines which have accumulated in active creek and river channels. Lake deposits generally consist of fine sand and silt, and mined terrace deposits consist of mounds of coarse gravel. Landslide deposits are combinations of soil and rock. Both active and inactive landslides occur in most of the units in the watershed. Landslides are plotted on Plate 3 and are discussed later in the text.

WATERSHED DATA AND STATISTICS

Mass wasting, streambank erosion, and sheet and gully erosion are the principal sediment sources in the main stem watershed. These processes can be greatly accelerated by human activities. Land use practices, such as road building, timber harvesting, and placer mining, affect the watershed stability to varying degrees in each tributary basin (Photo 3). Cumulative impacts from minor amounts of land use generally have little modifying effect. However, as human activity in a basin increases, cumulative downstream impacts can alter the natural balance of forces in the basin. On denuded land, the ratio of rainfall to runoff can approach one. Resultant increased runoff promotes erosion in the upper reaches and sedimentation in the lower, and loss of land productivity and water quality.

A problem with resource planning in the watershed has been a general lack of information from which to make intelligent land-use decisions. This investigation will help fill the gap. Watershed data are presented in the form of maps, including subbasins, landslides, geology, timber harvests and burns, mine locations and instability and erosion hazards.

A geologic map was compiled from the most recent data available. Landslides and accelerated stream channel erosion scars ("guts") were plotted on stereo-paired aerial photographs and transferred onto a base map. Timber harvest data were gathered from many sources and plotted by method and year of harvest. Stream turbidities during high flows were measured and compared and mine locations were plotted.

Landslides

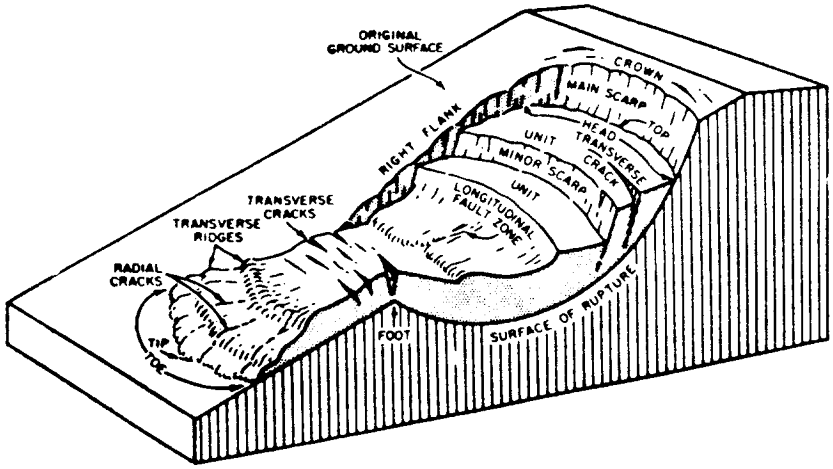
Landslides are found throughout the watershed. Those mapped on Plate 3 were plotted from aerial photo interpretation. Identification was based on typical landslide features, such as bowl-shaped and hummocky topography, sag ponds, irregular drainage, and large lag boulders in stream channels (Figure 4).

Common types of landslides that occur in the basin include debris slides, rock slides and falls, slumps, earth and debris flows, and complex (translational-rotational) slides.

Landslides have been divided into active and inactive categories, based on observable features which suggest recency of activity.

Active landslides display evidence of recent movement, such as fresh barren scarps, jackstrawed trees, displaced roads (Photo 4) and stream channels, and clusters of large rocks in the stream channels. The active classification includes streams and gullies with extensive or accelerated bank erosion. Many of the active landslides originated during and after the December 1964 flood. Vegetation on active landslides is sparse, with willows, grass, and brush predominant.

Photo 3. The photo shows the confluence of Trinity River (left) and Canyon Creek (right) near Junction City. The Trinity flows along the contact between the North Fork terrane on the left and Salmon Hornblende Schist on the right. Terraces, some of which have been mined for gold, line the Trinity. Benjamin Flat, directly across the Trinity from Canyon Creek mouth was the site of the Bergin hydraulic mine, in operation until 1946. The over-steepened slopes left behind by this operation are the sites of two recent landslides. Note also the narrow, sinuous piles of dredger tailings along the Trinity.



Nomenclature of the parts of a landslide

MAIN SCARP–A steep surface on the undisturbed ground around the periphery of the slide, caused by movement of slide material away from the undisturbed ground. The projection of the scarp surface under the disturbed material becomes the surface of rupture.

MINOR SCARP–A steep surface on the disturbed material produced by differential movements within the sliding mass.

HEAD–The upper parts of the slide material along the contact between the disturbed material and the main scarp.

TOP–The highest point of contact between the disturbed material and the main scarp.

FOOT–The line of intersection (sometimes Buried) between the lower part of the surface rupture and the original ground surface.

TOE–The margin of disturbed material most distant from the main scarp.

TIP–The point on the toe most distant from the top ot the slide.

FLANK–The side of the landslide.

CROWN–The material that is still in place, practically undisturbed, and adjacent to the highest parts of the main scarp.

ORIGINAL GROUND SURFACE–The slope that existed before the movement which is being considered took place. If this is the surface of an older landslide, that fact should be stated.

LEFT AND RIGHT–Compass directions are preferable in in describing a slide, but if right and left are used they refer to the slide as viewed from from the crown.

NOTE: Adapted from " Landslides and Engineering Practice", Highway Research Board, Special Report 29.

Parts of a Landslide

Photo 4. Slump near Rush Creek north of Weaverville on Highway 3.

Inactive landslides generally have well developed and easily recognized slide topography (Figure 4). Bowl- or spoon-shaped depressed areas are bounded by steep crown and flanking slopes. Flat lobes and irregular hummocky topography are well defined. Depressed sags and ponds, water seeps, and water-loving vegetation are common. Vegetation is generally a well established mature forest stand but may vary in type and density from surrounding stable areas. Old-growth conifers with bowed trunks occur within portions of these slides. This feature may indicate that deep-seated movement is presently occurring at slow rates. Inactive landslides define areas of past instability and indicate sensitivity to erosion and mass wasting. Timber harvesting at these sites may cause problems, such as at the Coffee Creek landslide, Section 11, T37N/R8W, MDB&M (Harrigan, 1978) (Photo 5). In the main stem watershed, the Rattlesnake Creek terrane contains the greatest percentage of area affected by active landslides; the Galice Formation is a close second, and the Trinity ultramafic sheet is third.

The Burnt Ranch slide in the Rattlesnake Creek terrane is the largest inactive slide within the watershed. Willow Creek also flows through this terrane and has a number of large inactive slides along its banks. Inactive slide masses are numerous in the serpentinized portion of the Trinity ultramafic sheet. The main channel of Coffee Creek is lined by these masses. A few large inactive slide masses are also found north of Swift Creek.

Almost the entire ridge separating the lower reaches of Grass Valley and Indian Creek is mantled with inactive slide masses. This area is also underlain by serpentinite.

The instability of schists throughout the basin is striking. In many cases, hillslopes have developed parallel to structural dip, called dip slopes. These are highly unstable. For example, a large number of debris slides occur on dip slopes in the Galice Formation along the lower part of the South Fork Trinity River. However, fewer landslides occur along the Trinity River from Willow Creek to Weitchpec, where hillslope development in the Galice is perpendicular to dip.

Timber Harvests and Burns

Extensive timber harvesting in Trinity County began after World War II (Plate 4). Both private and public entities are involved in timber harvesting. Most of the public land is managed by the U. S. Forest Service and the Bureau of Land Management (BLM). Harvesting on private land must conform to California Timber Harvest Practices Act of 1973, as administered by the California Department of Forestry (CDF). However, environmental damage can still occur where harvests are ill-conceived (Photos 6a-b).

Many sources were consulted for the Timber Harvest Map data. Private timber harvest records were obtained from the County Assessors' offices in Weaverville and Eureka. California Department of Forestry

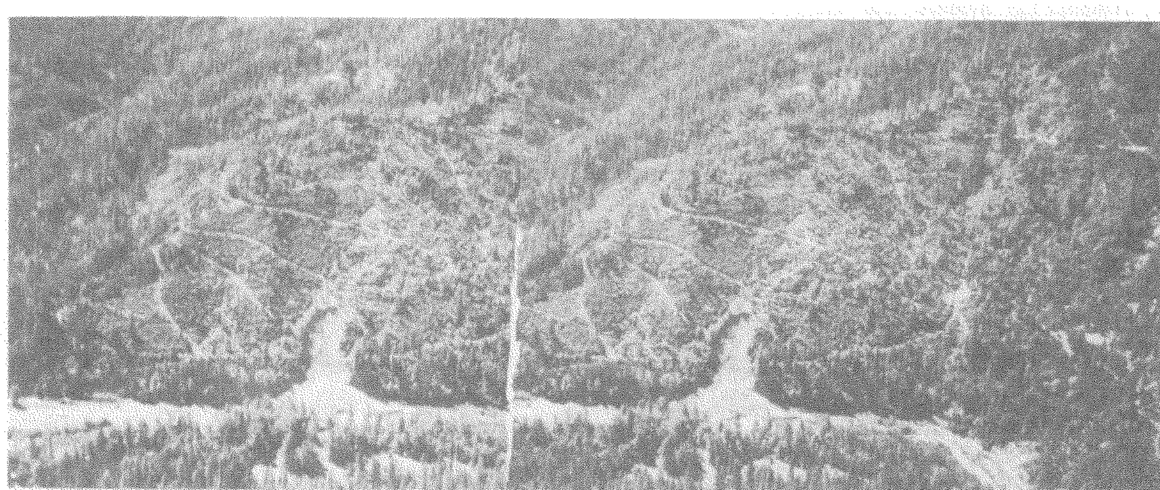


Photo 5. Stereo pair of Coffee Creek landslide, looking south. Coffee Creek flows from right to left. Logged area is a large, old landslide scar with the slide deposit at its toe. Present slide is the partial reactivation of this toe deposit.

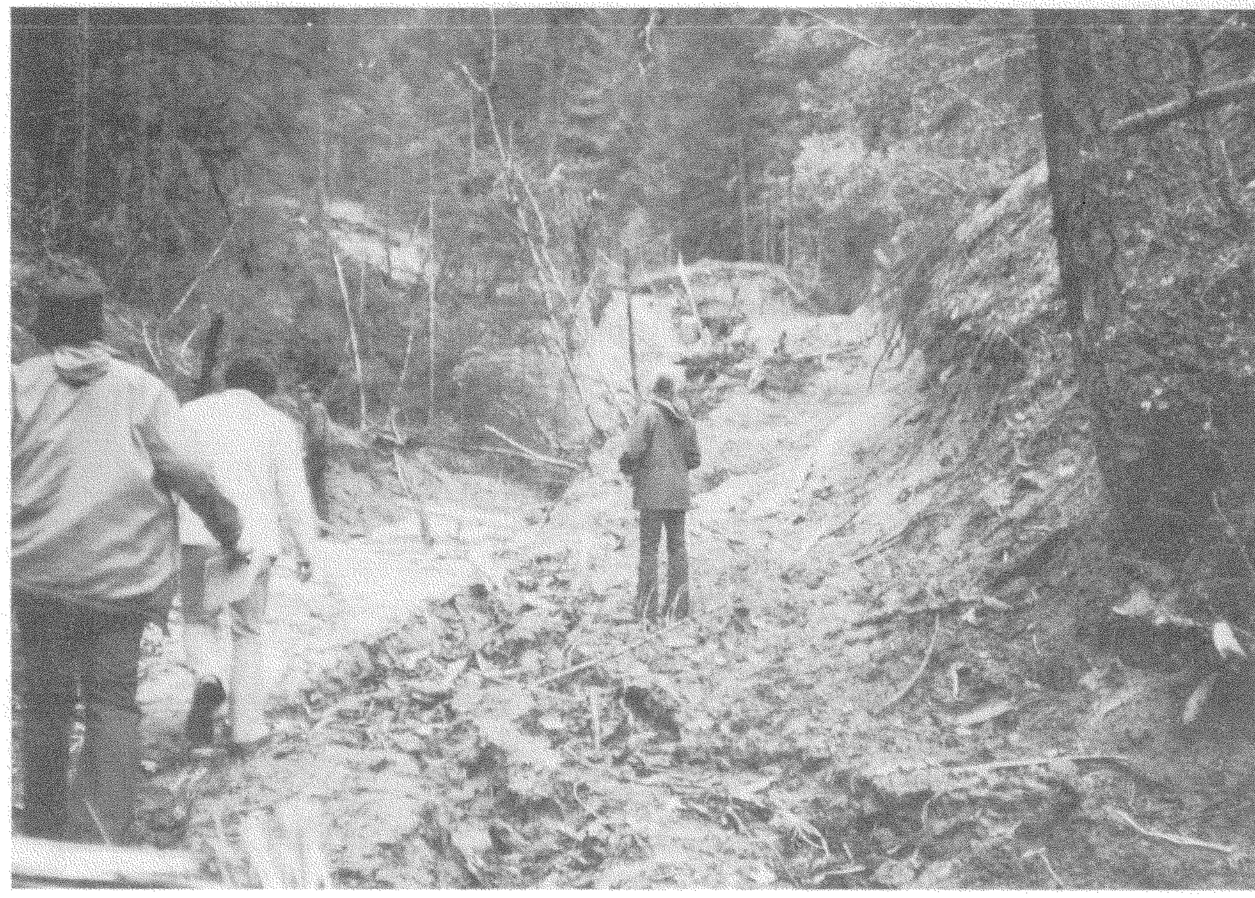


Photo 6a. This scene of the upper reach of Alder Gulch near Lewiston shows results of a poorly conceived timber harvest operation. Roads and landings were poorly located and constructed on the frail bedrock and improper stream channel designation allowed tractor skidding in draws. The bedrock in the area is the erodible Shasta Bally Batholith.

Photo 6b. Deposit of sediment derived from area shown in 6a. Channel on right shows a natural stream-channel condition for area and bedrock.

offices keep records of private harvests from 1974. Timber records for the Hoopa Indian Reservation were provided by the Bureau of Indian Affairs, Hoopa office. Harvest records on federal land were obtained from National Forest headquarters in Redding and Eureka, from individual Ranger Station District offices at Willow Creek, Hayfork, Harrison Gulch, Big Bar, Weaverville, Mount Shasta, and from the BLM office in Redding.

Data are plotted on Plate 4 by decade and method of harvest.

Listed below are the type and amount of timber harvesting that was taken place in the main stem watershed, where 42 percent (2 172 km^2) has been harvested.

Clear cut area	1 325 km^2 (25.6%)
Selective cut area	847 km^2 (16.4%)

Some of the timber sale maps used in preparation of the Timber Harvest Map were difficult to interpret. This could result in errors in the map, but the overall effect is probably negligible.

Fires in the watershed are also plotted on Plate 4. Fires have nearly the same effect on the hillslope as clearcutting, although burn areas usually do not suffer soil disturbance from roads, skid trails, etc. After a burn or a clearcut operation, revegetation is critical. Heavy rains following wildfires often result in tragic soil losses.

Mining Activities

Mining was the primary economic activity in Trinity County until after World War II, when logging became predominant. Over 500 claims are listed for Trinity County; the 72 largest are plotted on Plate 5. Many operations were short-lived because gravels were too coarse to work. Bucket and dragline dredges excavated most of the stream and terrace gravels along the Trinity and many of its tributaries. Hydraulic mining used huge nozzles with enormous pressure to scour terrace gravels and older gold-bearing sediment from hillsides. One of the largest hydraulic mines in the world was the LaGrange Mine (#40, Plate 5) where more than 76 million m^3 of gravel was removed from a hilltop west of Weaverville. Much of this displaced sediment rests in the buried stream valley of Oregon Gulch (Photo 7). Today, streams which were heavily mined, such as Canyon and Coffee Creek, are choked with gravel, but show little turbidity.

Turbidity

Turbidity in water is an optical property attributable to suspended and colloidal matter which disturbs clarity and reduces the penetration of light.

Photo 7. Vertical view of Oregon Gulch. The gulch has been filled with tailings from the LaGrange hydraulic mine. Oregon Gulch flows as a braided stream through the area during storms. Highway 299 crosses along the north side of the deposit.

Excess stream turbidity is an obvious water quality problem. Turbid waters must undergo costly treatment before industrial and domestic use; their sediments fill reservoirs, diminish recreation, and may ruin fisheries.

Silt, clay, finely divided organic matter, and algae cause turbidity. During summer months when runoff is low, turbidity is caused mainly by phytoplankton and other micro-organisms which proliferate in sunlight. During rainy winter months, suspended sediment causes high turbidity.

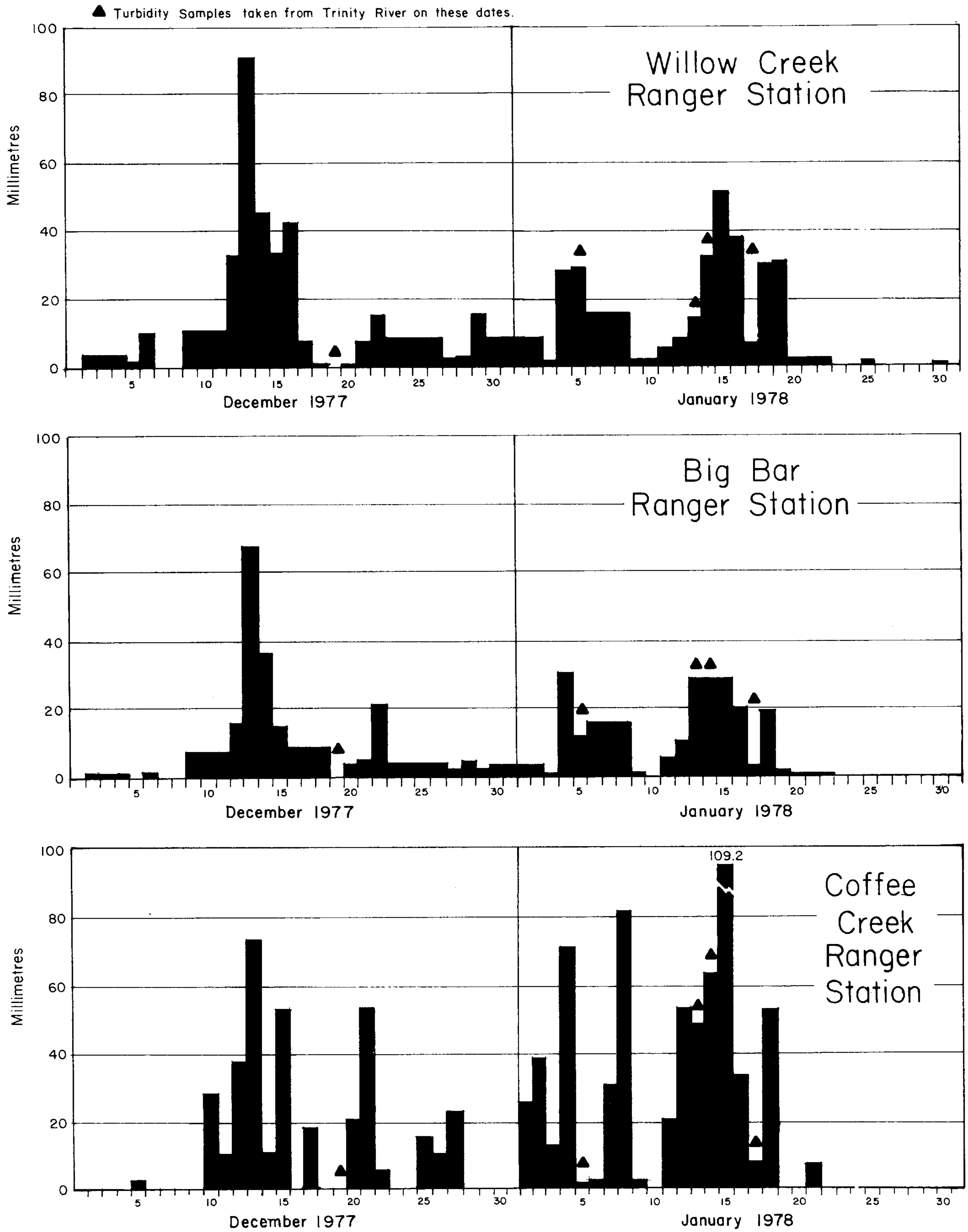
Correlation of simultaneous turbidity samples within the basin provides a quick and useful analytical tool for quantitatively gauging watershed response (Macy, 1976). Sampling was used in this study as a qualitative tool rather than one for precise measurement of sediment loads. Turbidity samples were collected as close as possible to storm peaks to identify source areas of turbid runoff. Figure 5 shows the daily rainfall for December 1977 and January 1978 with designated sampling dates. Appendix C, Table 1, lists sampled turbidities over the watershed for each date by station.

Turbidity samples were collected from stream cross-sections, when possible, over a four-hour period during the rising stage of the river immediately prior to cresting. Other samples were taken to determine long-term turbidity patterns. Depth-integrated samples (samples taken continuously along the depth profile) were not necessary for determination of turbidity, as the stream was totally mixed and coarser suspensate settles too quickly to be measured in the laboratory and is not a factor in long-term turbidity. The very fine sediments responsible for the high turbidity are likely to be more evenly distributed throughout the water column. Plastic sample bottles were stored in covered boxes and analyzed in the laboratory within 48 hours.

Turbidity samples were filtered through a 0.45-micron Milli-Pore filter pad. These turbidity pads, placed on a watershed map at the location where the samples were collected, show graphically relative turbidities of streams in the watershed. The turbidity was also analyzed with the Department's HAC Laboratory 2100A Nephelometer. This device estimates the cloudiness of the sample by measuring, collectively at different angles, the scattering of light by the suspended sediment. Turbidity measurements are in Nephelometer Turbidity Units (NTU). These are approximately equal to Jackson Turbidity Units and Formazin Turbidity Units.

Grass Valley Creek, Indian Creek, and Browns Creek had turbidities ranging from 600 to 1,400 NTUs, the highest measured during the study period. Roughly half of their watershed had been logged in the past 25 years, mostly clearcut in the 50s and 60s, and selective-cut in the 70s. The very high turbidities suggest that the soils and bedrock are quite sensitive to human activities.

Figure 5



Daily Rainfall

In general, 10 NTUs is the maximum allowable for drinking water distribution and 30 NTUs is considered the limit of fishability.

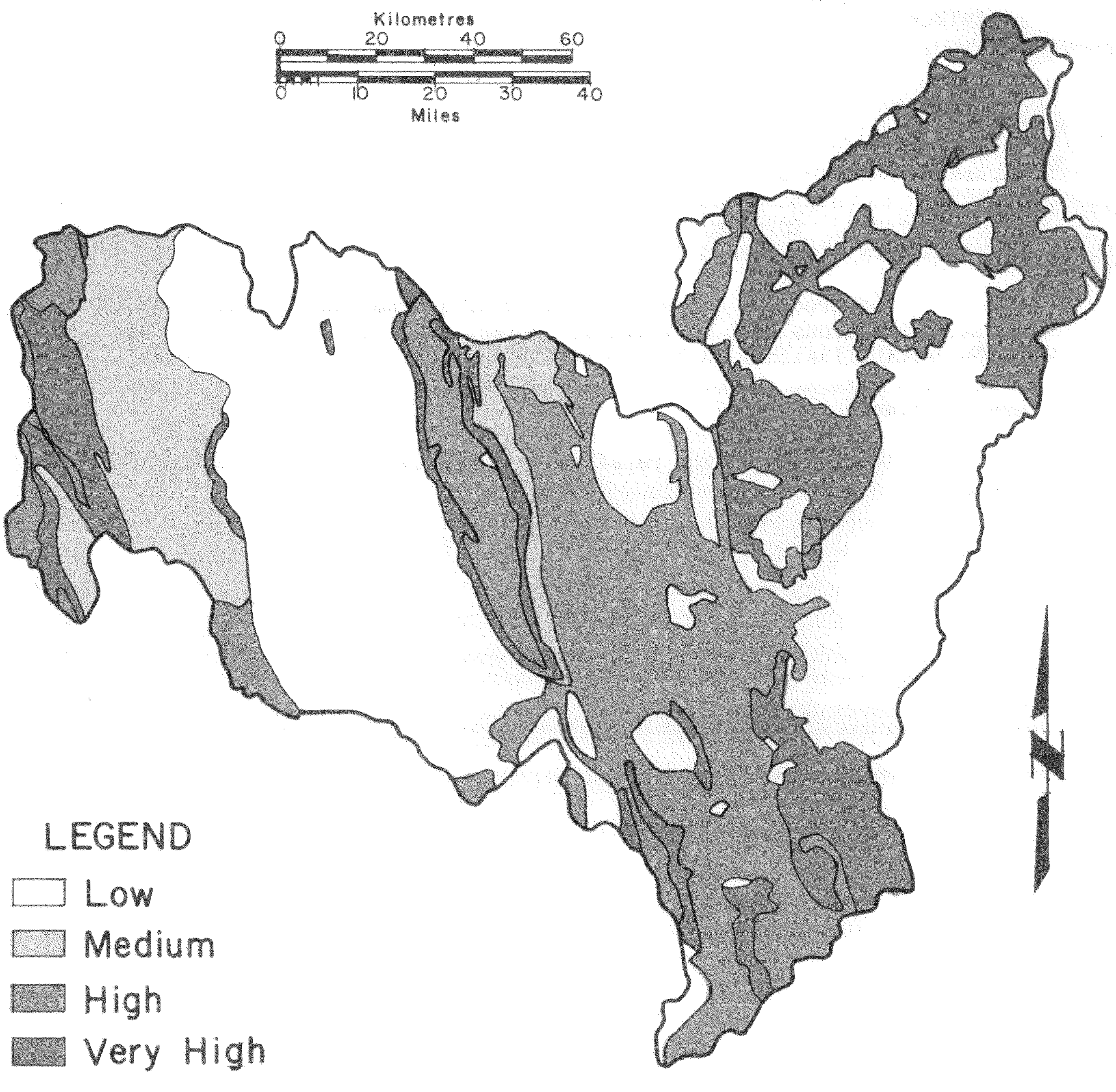
Watershed Instability and Erosion Hazard Rating

The instability and erosion hazard map (Figure 6) is a generalized map, based on landslides, topography, geology, watershed reconnaissance and stream turbidity. It is not site specific. Site specific landslide and erosion hazards must be evaluated by independent geotechnical investigations. This map divides the watershed into areas of low, medium, high and very high hazard.

Construction activity on soils of medium hazard rating means normal precautions must be taken to prevent surficial soil erosion and slope destabilization. A higher rating reflects an unstable, erodible soil where careful planning and use must be practiced and highly sensitive areas avoided.

Table 1 shows the relative instability of geologic units in the basin.

Figure 6



Instability and Erosion Hazard Map Main Stem Trinity River Watershed

TABLE 1

GENERALIZED INSTABILITY AND ERODIBILITY HAZARD

	Erosion Resistance	Slope Stability	Sediment Yield	Turbidity Produced	Landslides Produced	% Logged	Hazard Rating* Unlogged	Hazard Rating* Logged
Eastern Klamath Subprovince								
Bragdon Formation	ML	M	L	M	L	40	L	L
Copley Greenstone	M	H	L	M	L	70	L	L
Serpentinite	L	L	H	M	H	40	H	VH
Gabbro	H	H	L	L	L	3	L	L
Granite°	H	H	M	M	L	2	L	?
Central Metamorphic Subprovince								
Salmon Hornblende Schist	L	M	H	M to VH	ML	30	M	VH
Abrams Mica Schist	M	H	M	M to VH	ML	60	?	H
North Fork Terrane								
Metasedimentary Rocks	M	M	L	L to H	ML	3	L	M
Metaigneous Rocks	L	L	M	L to H	M	3	M	H
Hayfork Terrane								
Upper	M	M	L	L	M	25	L	M
Lower	H	M–H	L	L	M	20	L	M
Rattlesnake Creek Terrane	L	L	H	M	H	70	M	VH
Galice	M	M	M	L	H	60	M	H
South Fork Mt. Schist	**							
Franciscan Formation	**							
Weaverville Formation	M	M	M	M	L	40	M	M
Intrusive Rocks								
Shasta Bally Batholith and Weaver Bally	VL	L	VH	VH	L	90	M	VH
Canyon Creek Pluton°	H	H	L	L	L	3	L	L
Ironside Mt. Pluton	H	M–H	L	L	L–M	25	L	L–M
Glacial Debris	M	M–H	M	L–M	L	30	L	L–M

L – Low, M – Medium, H – High, ML – Medium Low, VH – Very High.
* Hazard rating derived from comparisons of logged and unlogged subbasins in same geologic unit.
** These units appear only in minor amounts in this watershed and could not be evaluated.
% Logged and landslide production derived from Plates 3 and 4 over 2.
o Glaciated.
? Evaluation not possible.

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APPENDIX A

SUBBASINS AND THEIR DRAINAGE AREAS IN MAIN STEM TRINITY RIVER WATERSHED

APPENDIX A

BASINS AND THEIR DRAINAGE AREAS IN MAIN STEM TRINITY RIVER WATERSHED

No.	Subbasin	Area in Hectares	No.	Subbasin	Area in Hectares
1.	Trinity River (above Clair Engle Lake)	43 814	22.	Feeny Gulch	1 427
2.	East Fork Trinity River	27 053	23.	Van Ness Creek	1 125
3.	Coffee Creek	31 005	24.	Bear Gulch	650
4.	Buckeye Creek	1 376	25.	Digger Gulch	525
5.	Hatchet Creek	523	26.	Papoose Creek	2 842
6.	Swift Creek	15 132	27.	Little Papoose Creek	554
7.	East Fork Stuart Fork	5 552	28.	Mooney Gulch	1 017
8.	Packer Gulch	331	29.	Eastman Gulch	1 364
9.	Clawton Gulch	331	30.	Jennings Gulch	4 769
10.	Unnamed	166	31.	Deadwood Creek	2 434
11	Unnamed	347	32.	Hoadley Gulch	1 002
12.	Bowerman Gulch	467	33.	Alder Gulch	428
13.	Smith Gulch	251	34.	Rush Creek	6 117
14.	Strope Creek	1 030	35.	Weaver Creek	13 220
15.	Little Mule Creek	341	36.	Trinity House Gulch	705
16.	Mule Creek	1 290	37.	Limekiln Gulch	226
17.	Buck Gulch	215	38.	China Gulch	85
18.	Unnamed	101	39.	Dutton Creek	1 249
19.	Unnamed	119	40.	McIntyre Gulch	204
20.	Stony Creek	1 513	41.	Tom Lang Gulch	816
21.	Bragdon Gulch	2 271	42.	Vitzthum Gulch	204
			43.	Grass Valley Creek	9 797

BASINS AND THEIR DRAINAGE AREAS IN MAIN STEM TRINITY RIVER WATERSHED

No.	Subbasin	Area in Hectares	No.	Subbasin	Area in Hectares
44	Indian Creek	8 978	66.	Sailor Bar Creek	1 343
45.	Reading Creek	8 247	67.	Big Bar Creek	2 665
46.	Browns Creek	19 096	68.	Bordy Creek	232
47.	Carr Creek	16 705	69.	Price Creek	2 223
48.	Sheridan Creek	331	70.	Unnamed	170
49.	Oregon Gulch	353	71.	Unnamed	294
50.	Stuart Fork	1 837	72.	Cutthroat Gulch	97
51.	Canyon Creek	16 784	73.	Logan Gulch	788
52.	Unnamed	195	74.	Wheel Gulch	686
53.	Maxwell Creek	1 274	75.	Unnamed	258
54.	Dutch Creek	2 465	76.	Manzanita Creek	3 204
55.	Bell Gulch	159	77.	Treloar Creek	185
56.	Soldier Creek	1 854	78.	Denny Creek	215
57.	Deep Gulch	137	79.	Whites Bar Creek	117
58.	Mill Creek	619	80.	Prairie Creek	889
59.	McKinney Gulch	262	81.	Little French Creek	1 729
60.	Unnamed	123	82.	Deer Creek	671
61.	Conner Creek	1 313	83.	Monkey Creek	293
62.	Unnamed	378	84.	Rock Bar Creek	237
63.	Miller Creek	175	85.	Unnamed	173
64.	Eagle Creek	793	86.	Unnamed	332
65.	Unnamed	106	87.	Pelletreau Creek	260

BASINS AND THEIR DRAINAGE AREAS IN MAIN STEM TRINITY RIVER WATERSHED

No.	Subbasin	Area in Hectares	No.	Subbasin	Area in Hectares
88.	French Creek	10 367	110.	Don Juan Creek	947
89.	East Fork of North Fork	12 560	111.	Unnamed	537
90.	North Fork Trinity River	27 827	112.	McDonald Creek	1 976
91.	New River	61 382	113.	Unnamed	149
92.	Little Swede Creek	217	114.	Hennessey Creek	819
93.	Swede Creek	855	115.	Unnamed	223
94.	Italian Creek	841	116.	Unnamed	230
95.	Little Sandy Bar Creek	164	117.	Unnamed	114
96.	Sandy Bar Creek	245	118.	Gray Creek	316
97.	Canadian Creek	2 402	119.	Unnamed	272
98.	Unnamed	166	120.	Cow Creek	176
99.	Rowdy Bar Creek	219	121.	Hawkins Creek	1 378
100.	Stetson Creek	355	122.	Quimby Creek	964
101.	Cedar Flat Creek	1 054	123.	Sharber Creek	1 590
102.	Mill Creek	1 610	124.	Bremer Creek	917
103.	Bidden Creek	323	125.	Coon Creek	1 405
104.	Little Bidden Creek	117	126.	Horse Linto Creek	17 332
105.	China Slide Creek	81	127.	Willow Creek	11 482
106.	Unnamed	73	128.	Kirkham Creek	716
107.	Collins Bar Creek	65	129.	Campbell Creek	1 825
108.	Unnamed	107	130.	Hospital Creek	583
109.	Dixon Bar Creek	157	131.	Supply Creek	4 186

BASINS AND THEIR DRAINAGE AREAS IN MAIN STEM TRINITY RIVER WATERSHED

No.	Subbasin	Area in Hectares	No.	Subbasin	Area in Hectares
132.	Captain John Gulch	378	137.	Mill Creek	12 927
133.	Tish Tang a Tang Creek	7 789	138.	Bull Creek	1 656
134.	Ferry Gulch	230	139.	Beaver Creek	843
135.	Hostler Creek	2 462	140.	Big Creek	772
136.	North Fork Creek	2 391	141.	Unnamed	561
				Additional area	62 500

APPENDIX B

FIFTY LARGEST SUBBASINS IN MAIN STEM TRINITY RIVER WATERSHED

FIFTY LARGEST SUBBASINS IN
MAIN STEM TRINITY RIVER WATERSHED

Order Number	Subbasin	Subbasin Number	Area in Hectares	Order Number	Subbasin	Subbasin Number	Area in Hectares
1.	New River	91	61 382	26.	Big Bar Creek	67	2 665
2.	Trinity River (above Clair Engle Lake)	1	43 814	27.	Dutch Creek	54	2 465
				28.	Hostler Creek	135	2 462
3.	Coffee Creek	3	31 005	29.	Deadwood Creek	31	2 434
4.	North Fork Trinity River	90	27 827	30.	Canadian Creek	97	2 402
5.	East Fork Trinity River	2	27 053	31.	North Fork Creek	136	2 391
6.	Browns Creek	46	19 096	32.	Bragdon Creek	21	2 271
7.	Horse Linto Creek	126	17 332	33.	Price Creek	69	2 223
8.	Canyon Creek	51	16 784	34.	McDonald Creek	112	1 976
9.	Carr Creek	47	16 705	35.	Soldier Creek	56	1 854
10.	Swift Creek	6	15 132	36.	Stuart Fork	50	1 837
11.	Weaver Creek	35	13 220	37.	Campbell Creek	129	1 825
12.	Mill Creek	137	12 927	38.	Little French Creek	81	1 729
13.	East Fork of North Fork	89	12 560	39.	Bull Creek	138	1 656
14.	Willow Creek	127	11 482	40.	Mill Creek	102	1 610
15.	French Creek	88	10 367	41.	Sharber Creek	123	1 590
16.	Grass Valley Creek	43	9 797	42.	Stony Creek	20	1 513
17.	Indian Creek	44	8 978	43.	Feeny Gulch	22	1 427
18.	Reading Creek	45	8 247	44.	Coon Creek	125	1 405
19.	Tish Tang a Tang Creek	133	7 789	45.	Hawkins Creek	121	1 378
20.	Rush Creek	34	6 117	46.	Buckeye Creek	4	1 376
21.	East Fork Stuart Fork	7	5 552	47.	Eastman Gulch	29	1 364
22.	Jennings Gulch	30	4 769	48.	Sailor Bar Creek	66	1 343
23.	Supply Creek	131	4 186	49.	Conner Creek	61	1 313
24.	Manzanita Creek	76	3 204	50.	Mule Creek	16	1 290
25.	Papoose Creek	26	2 842				

APPENDIX C

TABLE 1 - TURBIDITY SAMPLING STATIONS IN MAIN STEM TRINITY RIVER WATERSHED

TABLE 2 - LIST OF PLACER MINES IN MAIN STEM TRINITY RIVER WATERSHED

TABLE 1

TURBIDITY SAMPLING STATIONS IN
MAIN STEM TRINITY RIVER WATERSHED

No.	Sampled Stream	12/19/77 NTU*	1/5/78 NTU	1/13/78 NTU	1/14/78 NTU	1/17/78 NTU	1/26/78 NTU
1	Klamath River downstream from Trinity River		90.		74.		34.
2	Klamath River upstream from Trinity River	46.	25.		17.		19.
3	Bull Creek				1.		1.6
4	Mill Creek	19.	14.	17.	11.5		10.
5	Hostler Creek			22.5	9.		4.5
6	Supply Creek		7.	4.5	2.5		2.1
7	Scottish Creek		20.	13.5	12.0		4.6
8	Trinity River at Hoopa	20.	135.	70.	138.		35.
9	Tish Tang a Tang Creek				2.5		0.9
10	Hospital Creek						1.4
11	Campbell Creek				23.		8.7
12	Coon Creek			4.			
13	Horse Linto Creek						
14	Trinity River at Willow Creek		120.	69.	118.		28.
15	Willow Creek	9.4	6.	4.	2.		3.3
16	Three Creeks						
17	Willow Creek upstream Three Creeks						
18	East Fork Willow Creek						0.6
19	Willow Creek upstream East Fork Willow Creek						2.3
20.	South Fork Trinity River	47.	145.	108.	136.		34.
21	Trinity River upstream from South Fork Trinity River	10.		23.5	65.		10.

* NTU = Nephelometer Turbidity Units

TABLE 1 (Continued)

No.	Sampled Stream	12/19/77 NTU	1/5/78 NTU	1/13/78 NTU	1/14/78 NTU	1/17/78 NTU	1/26/78 NTU
22	Trinity River at Hawkins Bar		52.		42.		7.3
23	New River				5.		
24	Trinity River at Cedar Flat	5.7	65.		45.		8.5
25	Mill Creek						7.3
26	Cedar Flat Creek						0.7
27	Big French Creek	1.3	2.5		5.5		1.1
28	Little French Creek						0.9
29	Trinity River at Big Bar		85.	47.			8.5
30	Price Creek						1.7
31	Manzanita Creek		1.5	2.			0.7
32	North Fork Trinity River			13.5			1.3
33	North Fork Trinity River upstream of East Fork of North Fork	2.8	4.				
34	East Fork of North Fork		2.5				
35	Trinity River at Benjamin Flat		90.	248.			13.
36	Canyon Creek	1.8	1.2	20.			0.9
37	Trinity River at Junction City		66.	360.			15.
38	Oregon Gulch						1.6
39	West Weaver Creek						2.
40	Garden Gulch						3.3
41	East Weaver Creek			12.5		14.	1.5
42	Little Browns Creek			25.		32.	2.7
43	Weaver Creek upstream from Little Browns Creek					63.	3.5
44	Weaver Creek at Douglas City	9.5	27.	35.		83.	2.5

TABLE 1 (Continued)

No.	Sampled Stream	12/19/77 NTU	1/5/78 NTU	1/13/78 NTU	1/14/78 NTU	1/17/78 NTU	1/26/78 NTU
45	Trinity River at Douglas City	3.	55.	740.	460.	188.	16.
46	Reading Creek	3.6	58.	750.		290.	3.2
47	Reading Creek at Clements Ranch						
48	Browns Creek	2.6	53.	290.		310.	10.
49	Browns Creek at Hazel Gulch						
50	Indian Creek	0.9	77.	1340.	600.	340.	3.4
51	Indian Creek at Freitas Gulch						
52	Trinity River at Vitzthum Gulch						18.
53	Grass Valley Creek					176.	35.
54	Little Grass Valley Creek					240	42.
55	Grass Valley Creek at Coltris Cabin						
56	Trinity River at Lewiston		30.	30.		4.	17.
57	Deadwood Creek						
58	Rush Creek		18.		47.		2.
59	Upper Little Browns Creek					20.	
60	Upper Rush Creek	4.2					4.5
61	Rush Creek Tributary					50.	4.8
62	Stuart Fork	3.	1.5			4.5	1.
63	Mule Creek					44.	11.
64	Stoney Creek						1.8
65	Buck Creek						5.
66	East Fork Stuart Fork	1.7	10.			10.	4.5
67	Swift Creek		5.5			7.	1.2
68	Hatchet Creek					32.	3.4

TABLE 1 (Continued)

No.	Sampled Stream	12/19/77 NTU	1/5/78 NTU	1/13/78 NTU	1/14/78 NTU	1/17/78 NTU	1/26/78 NTU
69	Buckeye Creek		49.			28.	2.7
70	Trinity River at Carrville	1.5	7.5				1.2
71	Coffee Creek	2.3	5.0			6.5	1.5
72	Trinity River at One-eyed Flat		6.5			8.5	1.5
73	East Fork Trinity River		7.0				1.6

TABLE 2

LIST OF PLACER MINES IN
MAIN STEM TRINITY RIVER WATERSHED

No.	Placer Mine Name	Location Section	T	R	Dates Worked
1	Albia	8,9	7N	8E	
2	Atomic Mining Co.	1	32N	10W	June 1946
3	Bates & Van Matre	33	34N	8W	
4	Batham Dredge	33	35N	8W	1939-1941
5	Beaudry	28,29, 32,33	35N	8W	
6	Bennett Hydraulic*	6	33N	12W	
7	Bergin*	18	33N	10W	To 1946
		12,13,24	33N	11W	
8	B. H. K. Dredge	20	33N	9W	July 1940-Oct. 1941 (5 locations)
9	Browns Creek*	9,16	33N	9W	Jan. through April 1947-mid-'60's
10	Buckeye*	19	37N	9W	Pre-1948 1948-1950 (3 owners)
11	Burger	12,13	34N	11W	
12	California Keystone*	6	35N	11W	
13	Canyon Placers, Inc.*	29,30,31	35N	10W	1940-1941, 1945, '46,'48,'50
14	Carrville Gold Company Dredge	17	37N	7W	Sept.1939-1943 March 1946-June 1947
15	Chapman & Fisher*	30	33N	10W	1871 (?), early 1946
16	Clear Creek Gold Dredging Co.	18	32N	9W	Aug.1947-48
17	Clipper	13,24	34N	11W	
18	Coro	14	36N	8W	
19	Corono	17,18	6N	6E	
20	Costa Ranch*	16	34N	9W	
21	Diener	20	35N	8W	
22	Dobbins Gulch Dredging Co.	19,30	33N	9W	1941-42
23	Eastman*	33,34	34N	8W	Pre-1914--Chinese, Jan.-June 1941 & 1942
24	English Tom	5,8	33N	8W	

*Employed hydraulic giants.

TABLE 2 (Continued)

No.	Placer Mine Name	Location Section	T	R	Dates Worked
25	Fairview Placers Dredge	18	35N	7W	Sept.1949-Dec.1956 June 1957-Apr.1958
26	French Bar	29,30	5N	8E	
27	Glacier & Junction	26	38N	9W	
28	Gold Dollar	24	34N	11W	
29	Golden Gravels	33,34	34N	11W	
30	Goldfield Consolidated*	35	34N	11W	1938 Dec.-Apr.1939-1950
31	Good Friday	19,20	33N	10W	
32	Hayward	25 30	5N 5N	7E 8E	
33	Heniger	34,35	38N	9W	
34	Ho Hat*	9	34N	11W	1948-?
35	Holland	16,17	38N	8W	
36	Indian Creek Dredge	5,8	32N	9W	To March 1949
37	Ingleside	27,28	35N	8W	
38	Junction City Dredge	35	34N	11W	Jan.1936-Apr.1948
39	Karrer*	26	39N	7W	
40	LaGrange*	3	33N	10W	1862-1918, 1932-1942, Jan.-July 1942
41	Lewiston Placers*	20	33N	8W	Jan.-July, 1941, 1942
42	Lucky Strike & Effie Belle	13,14, 23,24	33N	10W	
43	Maple Creek	5,6	32N	10W	
44	McAfee Bar	27,33	7N	7E	
45	Minersville	22,27	35N	8W	
46	Mires & Underseath Dredge	31	38N	9W	May 1947-1950 Jan.-Sept.1951
47	Monitor	33	37N	11W	
48	Niedra	33	38N	9W	
49	North Fork Hydraulic*	29	34N	11W	March-Dec.1942
50	Oregon Gulch Dredging Co.	7	33N	10W	1950-March 1953
51	Oro Del Lomas Mining Co.	29,30	5N	8E	1949-?
52	P & W Mining Co.	25	5N	7E	

*Employed hydraulic giants.

TABLE 2 (Continued)

No.	Placer Mine Name	Location Section	T	R	Dates Worked
53	Pansy	15	36N	8W	
54	Picket and Stofer	5,6	33N	8W	
		32	34N	8W	
55	Placer Exploration Co.	1,12	32N	10W	1941-Sept.1947 (3 locations)
		32	36N	7W	
56	Price	4.5	33N	12W	
57	Rainbow	32	32N	8W	
58	Rex Hydraulic*	7	33N	9W	1930-1950 (2 locations)
59	Rising Sun Group	22,27	34N	9W	
60	Roe	31	33N	9W	
		6	32N	9W	
		1	32N	10W	
61	Sheridan	19	33N	10W	
62	Snow Gulch	21,28	37N	7W	
63	Steiner Flat	35,36	33N	10W	
64	Swanson*	23	6N	5E	1920-1960
65	Thompson Divide Mining Co.	11	36N	7W	Jan.-July 1946
		8	33N	8W	April-July 1947
66	Tinsley & Treloat*	5	33N	12W	Jan.-June 1945
67	Tolly Hill	34	35N	9W	
68	Union Hill	6	32N	9W	
69	Up Grade	18	6N	7E	
70	Upham	29,30	32N	8W	
71	Uphill Mining Co.	1	34N	11W	Nov.1949-Oct.1950 (2 locations)
72	Yuba Consolidated Goldfields	45,8,9	36N	7W	
73	Hoopa District	Hoopa Valley			Active in 1965

*Employed hydraulic giants.